

CLAIMS

1. A piezoelectric/electrostrictive ultrasonic linear motor, comprising:
 - a piezoelectric or electrostrictive substrate, with an electrode provided on each of both surfaces of the piezoelectric or electrostrictive substrate;
 - an elastic body, to one surface or each of both surfaces of which the piezoelectric or electrostrictive substrate is attached;
 - a movable shaft coupled at an end thereof to the elastic body or the piezoelectric or electrostrictive substrate attached to the elastic body, the movable shaft being operated in conjunction with displacement of the piezoelectric or electrostrictive substrate; and
 - a movable body to be moved along the movable shaft.
2. The piezoelectric/electrostrictive ultrasonic linear motor according to claim 1, wherein the piezoelectric substrate is polarized.
3. The piezoelectric/electrostrictive ultrasonic linear motor according to claim 2, wherein the movable body is in close contact with an outer surface of the movable shaft such that the movable body covers at least part of the movable shaft.
4. The piezoelectric/electrostrictive ultrasonic linear motor according to claim 3, wherein the movable shaft has a circular or angled slender rod shape and transmits vibration of the piezoelectric or electrostrictive substrate at high efficiency.
5. The piezoelectric/electrostrictive ultrasonic linear motor according to any one of claims 1 through 4, wherein, when the movable shaft vibrates in conjunction with the

displacement of the piezoelectric or electrostrictive substrate and an inertia force of the movable body is greater than a frictional force between the movable shaft and the movable body, the movable body is moved along the movable shaft.

6. The piezoelectric/electrostrictive ultrasonic linear motor according to any one of claims 1 through 4, wherein the movable body comprises: a friction member being in close contact with the outer surface of the movable shaft; a weight provided around an outer surface of the friction member; and an elastic shell fitted over an outer surface of the weight to hold both the friction member and the weight around the movable shaft, wherein the movable body is fitted over the movable shaft.

7. A method of driving a piezoelectric/ electrostrictive ultrasonic linear motor, having an elastic body to which at least one piezoelectric or electrostrictive substrate is attached; a movable shaft coupled to the elastic body or the piezoelectric or electrostrictive substrate attached to the elastic body; and a movable body to be moved along the movable shaft, the method comprising:

the step (a) of applying a voltage, which varies from a first voltage to a second voltage, to electrodes provided on both surfaces of the piezoelectric or electrostrictive substrate during a first period; and

the step (b) of applying a voltage, which varies from the second voltage to the first voltage, to the electrodes provided on both surfaces of the piezoelectric or electrostrictive substrate during a second period after the step (a), wherein,

when an inertia force of the movable body is greater than a frictional force between the movable body and the movable shaft which vibrates in conjunction with displacement of

the piezoelectric or electrostrictive substrate during the step (a) or step (b), the movable body is moved along the movable shaft.

8. The method of driving the piezoelectric/ electrostrictive ultrasonic linear motor according to claim 7, wherein the step (a) and step (b) are repeated.

9. The method of driving the piezoelectric/ electrostrictive ultrasonic linear motor according to claim 7, wherein the first period is longer than the second period.

10. The method of driving the piezoelectric/ electrostrictive ultrasonic linear motor according to claim 7, wherein the first period is shorter than the second period.

11. The method of driving the piezoelectric/ electrostrictive ultrasonic linear motor according to any one of claims 7 through 9, wherein, during the second period, the inertia force of the movable body is greater than the frictional force between the movable body and the movable shaft, so that the movable body is moved along the movable shaft.

12. The method of driving the piezoelectric/ electrostrictive ultrasonic linear motor according to claim 7, 8 or 10, wherein, during the first period, the inertia force of the movable body is greater than the frictional force between the movable body and the movable shaft, so that the movable body is moved along the movable shaft.